

AMENDMENTS TO THE CLAIMS

The following is a complete, marked up listing of revised claims with a status identifier in parentheses, underlined text indicating insertions, and strikethrough and/or double-bracketed text indicating deletions.

LISTING OF CLAIMS

1. (CURRENTLY AMENDED) A colloidal cupric compound of formula (I):



wherein A and B are anions,

$$1 \leq x \leq 2,$$

$$0 \leq y \leq 2,$$

$$mx + ny = 2;$$

wherein m and n are coefficients equal to oxidation numbers of the anions A and B, respectively,

wherein the anion A is selected from the group consisting of ~~Cl⁻, Br⁻, I⁻, F⁻, NO₃⁻~~ SO₄²⁻, PO₄³⁻, OH⁻, RCOO⁻, tartrate²⁻, ~~citrate³⁻~~ and amino acid residues;

wherein R is selected from the group consisting of hydrogen, a C₁-C₂₀ straight chain hydrocarbon, a C₁-C₂₀ branched hydrocarbon and an aromatic group;

wherein the anion B, if present, is OH⁻,

wherein the colloidal cupric compound made by a process comprising the steps of:

purifying a an aqueous Cu^{2+} solution by adding an oxidizing agent and H_3PO_4 to the solution and purifying the aqueous solution, the aqueous solution being substantially free of organic solvents, and

raising the pH of the aqueous solution to form colloidal particles of the colloidal cupric compound, and

wherein the colloidal particles are of sufficiently small size that they remain suspended in the aqueous solution substantially indefinitely~~cupric compound does not fall out of the solution.~~

2. (ORIGINAL) The colloidal cupric compound of claim 1, wherein the Cu^{2+} solution is prepared from $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

3. (CURRENTLY AMENDED) The colloidal cupric compound of claim 1, wherein said purifying step further includes the steps of:

adjusting the pH to 3;

heating the solution to form solids; and

removing the solids from the solution to form a purified solution.

4. (PREVIOUSLY PRESENTED) The colloidal cupric compound of claim 1, wherein the oxidizing agent is selected from the group consisting of H_2O_2 and bleach.

5. (ORIGINAL) The colloidal cupric compound of claim 3, wherein adjusting the pH to 3 is performed by adding Na_2CO_3 solution.

6. (CURRENTLY AMENDED) The colloidal cupric compound of claim 1, wherein the process further comprises:

adding an organic solvent to the aqueous solution to form an organic solvent solution in which the colloidal particles will agglomerate to form larger secondary particles of the cupric compound, the secondary particles tending to precipitate from the organic solvent solution~~a precipitate~~; and collecting the precipitate.

7. (PREVIOUSLY PRESENTED) The colloidal cupric compound of claim 6, wherein the organic solvent is selected from the group consisting of methanol and acetone.

8. (ORIGINAL) The colloidal cupric compound of claim 6, wherein the precipitate is dried by nitrogen flow.

9. (CURRENTLY AMENDED) A process for producing a colloidal cupric compound of formula (I):



wherein A and B are anions,

$$0 \leq x \leq 2,$$

$$0 < y \leq 2, \text{ and}$$

$$mx + ny = 2;$$

wherein m and n are coefficients equal to oxidation numbers of the anion A and B, respectively,

wherein the anion A is selected from the group consisting of Cl^- , Br^- , I^- , F^- , NO_3^- , SO_4^{2-} , PO_4^{3-} , OH^- , RCOO^- , tartrate $^{2-}$, citrate $^{3-}$ and amino acid residues, and

wherein R is selected from the group consisting of hydrogen, a C_1 - C_{20} straight chain hydrocarbon, a C_1 - C_{20} branched hydrocarbon and an aromatic group;

the process comprising:

purifying a Cu^{2+} solution by adding an oxidizing agent and H_3PO_4 to the solution and purifying the solution, and

raising the pH of the solution to form colloidal particles, the colloidal particles consisting essentially of the cupric compound or a basic salt thereof.

10. (PREVIOUSLY PRESENTED) The process of claim 9, wherein the Cu^{2+} solution is prepared from $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

11. (CURRENTLY AMENDED) The process of claim 9, wherein said purifying step further includes the steps of:

adjusting the pH to 3;

heating the solution to form solids; and

removing the solids to form a purified solution.

12. (CURRENTLY AMENDED) The process of claim 9, wherein the oxidizing agent is

selected from ~~the~~a group consisting of H_2O_2 and bleach.

13. (ORIGINAL) The process of claim 11, wherein adjusting the pH to 3 is performed by adding Na_2CO_3 solution.

14. (PREVIOUSLY PRESENTED) The process of claim 9, wherein the process further comprises:

adding an organic solvent to the solution to form a precipitate; and
collecting the precipitate.

15. (CURRENTLY AMENDED) The process of claim 14, wherein the organic solvent is selected from ~~the~~a group consisting of methanol and acetone.

16. (ORIGINAL) The process of claim 14, further comprising drying the precipitate by nitrogen flow.

17. (ORIGINAL) A method of controlling fungal diseases in plants comprising the step of applying to said plants a fungicide comprising the colloidal cupric compound of claim 1.

18. (CANCELED)

19. (ORIGINAL) The method of claim 17, wherein the fungicide is colloidal copper citrate.

20. (CANCELED)

21. (CURRENTLY AMENDED) The method of claim 17, wherein the fungicide is a colloidal copper citrate solution containing about 50 mg/L copper.

22. (CANCELED)

23. (PREVIOUSLY PRESENTED) A method of controlling fungal diseases in plants comprising the step of applying to said plants a fungicide made according to the process of claim 9.

24. (PREVIOUSLY PRESENTED) The method of claim 23, wherein the fungicide is colloidal copper citrate.

25. (PREVIOUSLY PRESENTED) The method of claim 23, wherein the fungicide is colloidal copper citrate solution containing about 50 mg/L copper.

26. (CURRENTLY AMENDED) A method of forming a colloidally stable sol comprising:

forming an aqueous cupric solution;
 purifying the aqueous cupric solution to produce a purified cupric solution substantially free of ions that can induce flocculation; and
 introducing a sufficient quantity of at least one anion into the purified cupric solution to form a colloidally stable sol wherein water is the continuous phase and a solid cupric compound or a basic salt thereof is the dispersed phase, and further wherein the colloidally stable sol is substantially free of stabilizing agents, the cupric compound or the basic salt thereof being insoluble or only slightly soluble in water, the cupric compound corresponding to Formula I III



wherein z is an integer greater than or equal to 1;

~~wherein~~ A is an anion having an oxidation number m and x is an integer selected from a group consisting of 1 and 2~~greater than 0;~~

B is an anion having an oxidation number n and y is an integer selected from a group consisting of 0, 1 and 2~~and integers greater than 0;~~ and

the relationship $mx + ny = 2z$ is satisfied.

27. (CURRENTLY AMENDED) A method of forming a colloidally stable sol according to claim 26, wherein:

forming the aqueous cupric solution includes dissolving a water-soluble cupric compound in water, the water being substantially free of organic solvents;

purifying the aqueous cupric solution includes forming and removing ~~iron~~ metal

precipitates by

adding an oxidizer to the aqueous cupric solution to form an oxidized aqueous cupric solution,

acidifying the oxidized aqueous cupric solution to form an acidified aqueous cupric solution,

heating the acidified aqueous solution and maintaining the acidified aqueous cupric solution at an elevated temperature for a treatment period to form a treated aqueous cupric solution and ~~iron~~ metal precipitates,

filtering the treated aqueous cupric solution to remove the ~~iron~~ metal precipitates and obtain the purified aqueous cupric solution; and

increasing the pH of the purified aqueous cupric solution in the presence of the at least one anion to form the colloidally stable sol wherein the average particle size is less than about 1 μm .

28. (PREVIOUSLY PRESENTED) A method of forming a colloidally stable sol according to claim 27, wherein:

the water-soluble cupric compound is a cupric salt selected from a group consisting of CuCl_2 and CuSO_4 ;

the ions that can induce flocculation include at least one ion selected from a group consisting of Fe^{2+} , Fe^{3+} and Al^{3+} ;

the oxidizer is selected from a group consisting of H_2O_2 , ozone, hypochlorites, bleach and H_3PO_4 ;

the elevated temperature is about 100 °C. and the treatment period is at least about ~~12 hours~~ 1 hour;

acidifying the aqueous cupric solution includes establishing a pH of about 3 in oxidized aqueous cupric solution,

increasing the pH of the purified aqueous cupric solution includes adding a sufficient quantity of a weak base to the purified aqueous cupric solution to achieve a pH of at least about 5 in the purified aqueous cupric solution.

29. (PREVIOUSLY PRESENTED) A method of forming a colloidally stable sol according to claim 28, wherein:

the weak base is selected from a group consisting of ammonia, sodium carbonate and sodium bicarbonate;

anion A is selected from a group consisting of OH^- , tartrate²⁻, citrate³⁻ and methionine residue; and

anion B is OH^- .

30. (PREVIOUSLY PRESENTED) A method of forming a colloidally stable sol according to claim 26, further comprising:

mixing the colloidally stable sol with a major portion of a water-miscible organic solvent to form a suspension of the cupric compound in a mixed solvent;

filtering the suspension to obtain a retentate including the cupric compound;

drying the retentate to remove the mixed solvent and obtain a dried cupric compound;

mixing the dried cupric compound with water to form a secondary colloidally stable sol.

31. (NEW) A colloidal cupric compound of formula (III):



wherein A and B are anions,

x is an integer that satisfies the relationship $1 \leq x \leq 2$,

y is an integer that satisfies the relationship $0 \leq y \leq 2$,

z is an integer that satisfies the relationship $z > 0$, and wherein

the relationship $mx + ny = 2z$ is satisfied;

wherein m and n are coefficients equal to oxidation numbers of the anions A and B, respectively,

wherein the anion A is selected from the group consisting of Cl^- , Br^- , I^- , F^- , NO_3^- , SO_4^{2-} , and citrate³⁻ and the anion B, if present, is OH^- ;

wherein the colloidal cupric compound made by a process comprising the steps of:

purifying an aqueous Cu^{2+} solution by adding an oxidizing agent and H_3PO_4 to the solution and purifying the aqueous solution, the aqueous solution being substantially free of organic solvents, and

raising the pH of the aqueous solution to form colloidal particles of the basic salt of the colloidal cupric compound, and

wherein the colloidal particles are of sufficiently small size that they remain suspended in the aqueous solution substantially indefinitely.